## IN THE SPECIFICATION:

Please replace the paragraph beginning at page 1, line 20, with the following amended paragraph:

An optical interferometer network may also ~~contian~~ contain more than one pair (or set) of paths from the input to the output port. Different pairs (or sets) of paths may then be interpreted as different ~~interfereometers~~ interferometers. The interference caused by individual interferometers may be ~~interogated~~ interrogated separately,

a.    by assigning a specific range of optical wavelengths, thus employing a wavelength division multiplexing (WDM) technique,

b.    by assigning a specific range of total transmission time delay to the paths ~~assosciated~~ associated with each interferometer, thus employing a time division multiplexing (TDM) technique,

c.    or by assigning a specific combination of input and output ports to the paths ~~assosciated~~ associated with each interferometer, thus employing a space division multiplexing (SDM) technique. An SDM system may for instance be interrogated by using optical switches to access different combinations of input and output ports sequentially, or by splitting the optical radiation from a single interrogation source into different interferometer sub-networks, and connecting one detector to the output of each sub-network.

Network interrogation employing combinations of WDM, TDM and SDM is also possible.

Please delete the paragraph beginning at page 5, line 34, which starts with "The objective of the invention is achieved with a method..."

Please replace the three paragraphs beginning at page 7, line 19, with the following amended paragraphs:

The control & signal processing unit (11) also controls the polarization modulator (2) and causes the input polarization state SOP0 launched into (3) to switch between two orthogonal states, denoted SOP0a and SOP0b in Fig. 2. The polarization switching period should equal $4\tau$, and the duty-cycle of the modulation should be 50%,

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as illustrated by the top curve in Fig. 2. The coupler (4), the lead fiber (5), the interferometer fiber (9), and the reflectors (7,8) should have negligible polarization dependent losses. The latter condition implies that the polarization states SOP1 and SOP2 reflected from (7) and (8), respectively, and interfering at the left hand side of (7) in Fig. 1, will also both be switching between two orthogonal states, denoted SOP1A, SOP1B, SOP2A, and SOP2B in Fig. 2. SOP1A and SOP1B may then generally be written in a Jones-vector notation as

$$SP01A = \vec{A} = K_1 \begin{bmatrix} \cos(\alpha) \\ \sin(\alpha)e^{i\gamma} \end{bmatrix} \qquad SP01B = \vec{B} = K_1 \begin{bmatrix} \cos(\alpha)e^{-i\gamma} \\ \sin(\alpha) \end{bmatrix}$$

$$SP01A = \vec{A} = K_1 \begin{bmatrix} \cos(\alpha) \\ \sin(\alpha)e^{i\gamma} \end{bmatrix} \qquad SP01B = \vec{B} = K_1 \begin{bmatrix} -\sin(\alpha)e^{-i\gamma} \\ \cos(\alpha) \end{bmatrix}$$

where the vector elements are chosen to represent the projections of the fields onto the orthogonal eigen-polarization states of the interferometer. By the interferometer eigen-polarization states we mean the orthogonal output SOPs generated when the SOP0 is adjusted so that SOP1 = SOP2. $K_1$ depends on the source power, and the losses in the transmission through (4,5,9) and in the reflections (7,8), while a and 7 are angles that depend on the birefringence properties of the lead fiber (5).

The chosen polarization projection states allow SOP2A and SOP2B to be written on the form

$$SP02A = J\vec{A} = K_2 e^{i\phi} \begin{bmatrix} \cos(\alpha) \\ \sin(\alpha)e^{i(\gamma+\theta)} \end{bmatrix} \qquad SP02B = J\vec{B} = K_2 e^{i\phi} \begin{bmatrix} \cos(\alpha)e^{-i\gamma} \\ \sin(\alpha)e^{i\theta} \end{bmatrix}$$

$$SP02A = J\vec{A} = K_2 e^{i\phi} \begin{bmatrix} \cos(\alpha) \\ \sin(\alpha)e^{i(\gamma+\theta)} \end{bmatrix} \qquad SP02B = J\vec{B} = K_2 e^{i\phi} \begin{bmatrix} -\sin(\alpha)e^{-i\gamma} \\ \cos(\alpha)e^{i\theta} \end{bmatrix}$$

where the Jones matrix

$$J = e^{i\phi} \begin{bmatrix} 1 & 0 \\ 0 & e^{i\theta} \end{bmatrix} \qquad\qquad (1)$$

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essentially describes difference between the SOP changes from SOP0 to SOP1 and that from SOP0 to SOP1.   $\phi = 2\pi v \tau$ is the interferometer phase that we want to measure, $v$ is the optical frequency, and $\theta$ is the birefringent phase-shift between the eigen-polarization states of the interferometer.   $K_2$ depends on losses in the transmissions and reflections of the system.

The two lower curves in Fig. 2 illustrate the switching of SOP1 and SOP2.  A periodic pattern consisting of 4 time slots can be observed, where:

-      SOP1A interferes with SOP2A in slot1,
-      SOP1B interferes with SOP2A in slot2,
-      SOP1B interferes with SOP2B in slot3,
-      SOP1A interferes with SOP2B in slot4.

The interference power will be composed by one term that depends on $\phi, \theta, \gamma$, and $\alpha$, and one term that is independent on these parameters.  The power from each time slot $n$ will produce an electrical signal $S_n$ at the detector output, which is proportional to the interference power.  Based on the given conditions, it can be shown that

$$\cancel{S_1 = 2K_3 \operatorname{Re}\{\vec{A}^+ J\vec{A}\} = a\cos(\phi_1)}$$

$$\cancel{S_2 = 2K_3 \operatorname{Re}\{\vec{B}^+ J\vec{A}\} = a\cos(\phi_2)} \tag{2}$$

$$\cancel{S_3 = 2K_3 \operatorname{Re}\{\vec{B}^+ J\vec{B}\} = a\cos(\phi_3)}$$

$$\cancel{S_4 = 2K_3 \operatorname{Re}\{\vec{A}^+ J\vec{B}\} = a\cos(\phi_4)}$$

$$S_1 = K_3 \operatorname{Re}\{\vec{A}^* J\vec{A}\} = a\cos(\phi_1)$$

$$S_2 = K_3 \operatorname{Re}\{\vec{B}^* J\vec{A}\} = b\cos(\phi_2)$$

$$S_3 = K_3 \operatorname{Re}\{\vec{B}^* J\vec{B}\} = a\cos(\phi_3)$$

$$S_4 = K_3 \operatorname{Re}\{\vec{A}^* J\vec{B}\} = b\cos(\phi_4)$$

where $K_3$ accounts for the detector responsivity and losses in (4,5), superscript $^+$ indicates conjugate transpose,

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$$\phi_1 = \phi + \theta + \varphi$$

$$\phi_2 = \phi + \theta/2 + \gamma - \pi/2$$

$$\phi_3 = \phi - \theta \qquad\qquad , and\ a^2 + b^2 = K_1 K_2 K_3^2. \qquad\qquad (3)$$

$$\phi_4 = \phi + \theta/2 - \gamma - \pi/2$$

$$\phi_1 = \phi + \theta + \varphi$$

$$\phi_2 = \phi + \theta/2 + \gamma + \pi/2$$

$$\phi_3 = \phi - \varphi \qquad\qquad \underline{,and\ a^2 + b^2 = (K_1 K_2 K_3)^2}.$$

$$\phi_4 = \phi + \theta/2 - \gamma + \pi/2$$

$\varphi$ is a function of $\theta$ and $\alpha$,

Please replace the two paragraphs beginning at page 9, line 24, with the following amended paragraphs:

We see from (Eq. 2) that the detected fringe amplitudes equal a in slots 1 and 3, and b in slots 2 and 4. Since $a^2 + b^2 = K_1 K_2 K_3^2$ $\underline{a^2 + b^2 = (K_1 K_2 K_3)^2}$ according to (Eq. 3), there can never be fading simultaneously in two neighboring time slots, and the sum of the signal to noise ratios of two neighboring time slots, limited by the fringe amplitude, will be independent on the birefringence parameters $\theta, \gamma$, and $\alpha$. Thus, the main objective of the present invention is satisfied.

It remains to combine the information carried by $\phi_1$, $\phi_2$, $\phi_3$, and $\phi_4$ into one single estimate for the interferometer phase delay, which according to (Eq. 1) is $\phi$ for one eigen-polarization and $\phi + \theta$ for the other eigen-polarization. In the preferred embodiment, the estimator

$$\phi = \frac{a^2(\phi_1 + \phi_2) + b^2(\phi_3 + \phi_4)}{a^2 + b^2} \qquad\qquad (4)$$

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$$\phi = \frac{a^2(\phi_1 + \phi_3) + b^2(\phi_2 + \phi_4 \pi)}{2(a^2 + b^2)}$$

is computed by the control & processing unit to estimate the interferometer phase delay. By combining (Eq. 3) and (Eq. 4) we see that $\phi$ in the absence of noise equals $\phi + \theta/2$, which is exactly the mean of the two eigen-polarization phase delays. $\phi$ is independent on the birefringence parameters $\gamma$ and $\alpha$ of the lead fiber, and thus the second objective of the present invention is satisfied. The weighting in (Eq. 4) of $\phi_1 + \phi_2$ $\phi_1 + \phi_3$ and $\phi_3 + \phi_4$ $\phi_2 + \phi_4 + \pi$ by a² and b², respectively, ensures that the signal to noise ratio of the estimator always will be close to a maximum.

Please replace the paragraph beginning at page 12, line 8, with the following amended paragraph:

The network (23 24) in Fig. 4 can be interrogated by a time division multiplexing (TDM) approach using the present invention, provided that all reflectors reflect the same wavelength, i.e. either $\lambda_1 = \lambda_2 = \lambda_3$, or the gratings must be replaced with broad-banded reflectors, and that the dual pass delays from the input/output (4) to the beginning of the different interferometers all are separated by at least in the order of $3\tau$. In this case, a possible fifth embodiment of the present invention uses a pulsed single wavelength source at wavelength $\lambda_1$, and only one detector without any wavelength demultiplexer in front, like the detector (10) in Fig. 1. The source and polarization modulator produces pulses with a duration of minimum $2\tau$, with polarization state switching between orthogonal polarizations within each pulse at a frequency that is an odc harmonic (or multiple) of $1/(4\tau)$ and which is higher than the inverse pulse duration, like illustrated for SOP0 in Fig. 2. The detected signal will consist of one time sequence for each pulse transmitted from the source, each sequence containing at least four time-slots originating from each sensor interferometer. The time slots contain information about the interference phases of individual sensors, encoded in the same way as for the output time-slot signals described in the first preferred embodiment. The control and proc ssing unit may thus extract the interference phases by separating, identifying and

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processing the information originating from each sensor in the same way as described for the first preferred embodiment.

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